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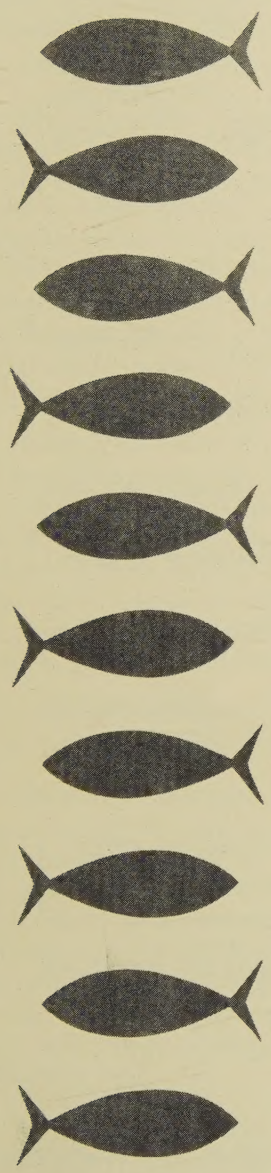

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The Report of Activities of the Southwest Fisheries Science Center is compiled at La Jolla from material submitted by the Center's staff. To change the delivery address of the Report of Activities, or to cancel your subscription, please notify Maryann Rodriguez at P.O. Box 271, La Jolla, CA 92038-0271. Telephone: (619) 546-7063.

ANTARCTIC ECOSYSTEM RESEARCH GROUP

La Jolla, California

Equipment and Supplies Shipped to Chile for the 1997 AMLR Research Cruise

On November 21, 1996, a cargo ship containing all the necessary scientific equipment and supplies for the 1997 Antarctic Marine Living Resources (AMLR) research cruise departed for Punta Arenas, Chile. The AMLR program has chartered a Russian research vessel, *Yuzhmorgeologiya*, for the 1997 cruise, which will begin and end in Punta Arenas.

The four fully loaded van containers—two owned by the government and two by the cargo shipping line—are expected to arrive in Punta Arenas in early January. This shipment of AMLR equipment and supplies to Chile is critical to the success of the 1997 cruise. Because of the complexity of the field research to be accomplished, as well as the vast quantity of equipment and supplies in this shipment, much time and effort were necessary for careful planning, procurement, and inventory.

During the research cruise, workers will collect scientific data mandated by the AMLR Convention Act of 1984. The act, a result of the U.S. membership in the Convention for the Conservation of Antarctic Marine Living Resources (CCAMLR), established the AMLR program within the National Marine Fisheries Service in order to support CCAMLR goals. (J. Martin, 619-546-5600)

Predator Studies and New Field Site Planned for Livingston Island

Because Seal Island was recently found to be geologically unstable and possibly unsafe, a new site for land-based research, Cape Shirreff on Livingston Island, has been selected. The Cape Shirreff site will be occupied by our AMLR team for the first time during the 1997 field season. Researchers in the AMLR program will continue the studies they have made during the last eight austral summers on the reproductive and foraging behavior of predators on breeding krill.

In association with a contractor, Dr. Wayne Trivelpiece, plans were made for scientific research to be undertaken during the 1997 field season. In addition, AMLR personnel worked with Antarctic Support Associates (logistics contractor to the National Science Foundation) to design housing and laboratory structures for Cape Shirreff, and to identify and procure all necessary building supplies for the new site. Also, AMLR personnel planned and procured all food and other necessary living supplies for the field team that will occupy the site in 1997.

Cape Shirreff will constitute a significant part of the AMLR program's land-based research effort. This research directly supports U.S. participation in the CCAMLR, an international treaty to manage and conserve living resources in the oceans surrounding Antarctica. During the coming field season at Cape Shirreff, the AMLR researchers will collect CCAMLR-mandated data on land-based predators. (J. Martin, 619-546-5600)

COASTAL FISHERIES RESOURCES DIVISION

La Jolla, California

Study of Age Structure, Growth, and Maturation of Pacific Sardine Completed

The October 1996 publication of *California Cooperative Oceanic Fisheries Investigations Reports* (which included seven papers by Coastal Division scientists) marked the completion of the first collaborative U.S.–Mexico study of the Pacific sardine (*Sardinops sagax*) stock along the West Coast. Age, growth, and maturation of Pacific sardine were determined over a broad geographic range. This information is critical, since data about the proportion of mature and immature fish are used to calibrate spawning biomass and total biomass with the daily egg production method and in models used to manage the stock.

A large commercial fishery for Pacific sardine flourished in California during the first half of this century. It declined dramatically because of poor recruitment and overfishing during the 1940s, and was closed in the 1970s. The fishery reopened in 1986. The recently completed research yielded a new understanding of the population dynamics of Pacific sardine. Age structure, growth, and maturation vary over a broad geographic area. Pacific sardine mature earlier and at a smaller size in the south than in the north. The fish are smaller and younger at maturity than they were in the 1930s and 1940s.

This international study of Pacific sardine, which furthered National Marine Fisheries Service (NMFS) goals of cooperation with Mexico's Instituto Nacional de la Pesca, should greatly facilitate management of the sardine resource. (J. Butler, 619-546-7149)

Sampling Techniques Evaluated for the Continuous Underway Fish Egg Sampler

A six-day test of the continuous underway fish egg sampler (CUFES) system to sample sardine and anchovy eggs in the spring of 1996 (Cruise 9603JD) was highly successful. The system was used during the remainder of that cruise and on the following California Cooperative Oceanic Fisheries Investigations (CalCOFI) cruise (9604JD).

The CUFES system was developed to sample menhaden eggs on the East Coast. It pumps water from 3 m below the surface at 640 L/min while a ship is under way. Fish eggs are collected on small filters and sampled at 5- to 30-minute intervals. The CUFES greatly improves the efficiency of sampling pelagic fish eggs for the daily egg production method (DEPM) of estimating population biomass.

During the test, egg samples were collected, identified, counted, and staged at sea. Sea surface temperature, salinity, chlorophyll, and oxygen content were continuously monitored for correlation with egg distribution. The data were used in the 1996 DEPM estimate of sardine biomass. Satellite imagery and subsurface physical oceanographic data were collected for later analysis and correlation. Six scientific papers are being prepared from information collected on the first two cruises.

A field calibration of CUFES and CalCOFI vertical egg tow (CalVET) data was completed. The CUFES system provided 701 samples along the 1,975-nmi cruise track (over 87,000 sq mi) as opposed to 44 discrete CalVET samples at individual stations.

The CUFES system offers several improvements over the standard CalVET system for monitoring fish abundance: (1) the cost per sample is lower; (2) sorting and identification can be done on board; (3) research vessels can be opportunistically used to monitor fish abundance; (4) satellite oceanography can help determine fish abundance; and (5) estimates will be more precise.

The CUFES will be used on all subsequent pelagic fish monitoring cruises. It should revolutionize future DEPM egg collections. (J. Hunter, 619-546-7127)

Design for Study of Hake Recruitment Nears Completion

The mean Pacific hake (*Merluccius productus*) biomass has been about 2.9 million tons for the past two decades, and has been sustained by occasional, massive recruitments. Researchers in the Coastal Division's Survey Systems Development and Evaluation Group have been working to identify the best method for early detection of recruitment success and for using egg and larval stages to monitor abundance.

A hake symposium was convened at the annual CalCOFI Conference in October 1996 to summarize existing knowledge on the ecology of Pacific hake. Scientists from the Southwest Fisheries Science Center (SWFSC), NMFS Alaska Fisheries Science Center, Canada, Namibia, and New Zealand participated; many of their papers will appear in the 1997 *CalCOFI Reports.*

In addition, a new synthesis of CalCOFI data on hake has been developed. It indicates latitudinal shifts in spawning habitat. The warmer the temperature, the farther north spawning occurs (a one-degree change in the mean temperature at 100 m shifts the habitat by 375 km). The division scientists have also developed adaptive sampling procedures to measure the abundance of hake larvae, which are difficult to measure with normal survey methods. Finally, new data collected by SWFSC scientists and collaborators demonstrate that hake live in an environment where food limits the growth and survival of hake larvae. This is clearly evident in new data on growth and mortality rates.

It now appears possible to institute useful, low-cost procedures using egg, larval, and juvenile data to predict recruitment failure in hake. It is also possible to design more efficient egg and larval surveys.

Surveys during January 1997 will collect data used to estimate the spawning rate of adult hake (eggs spawned per gram of hake per day). A report on other research on hake abundance being conducted at the SWFSC's Tiburon Laboratory can be found later in this publication. (J. Hunter, 619-546-7127)

MARINE MAMMAL DIVISION

La Jolla, California

Marine Mammal Stock Assessment Draft Reports Submitted

Under the 1994 amendments to the Marine Mammal Protection Act, NMFS and the U.S. Fish and Wildlife Service were required to draft stock assessment reports for all marine mammals within the U.S. Exclusive Economic Zone. The Marine Mammal Division's recently revised reports included significant new information on the abundance of cetaceans and pinnipeds.

The primary goal of the Marine Mammal Protection Act is to ensure that human-caused mortality and serious injury do not cause any marine mammal stock to be reduced below its optimum sustainable population level. Stock assessment reports are to be reviewed annually for strategic stocks and stocks for which significant new information is available; they are reviewed at least once every three years for all other stocks. The agencies are to make these reports available for public review and comment before the final reports are prepared in consultation with regional scientific review groups. The final stock assessment reports will be published in 1997.

The stock assessment reports include (1) a description of the stock, including its geographic range; (2) a minimum population estimate, a maximum net productivity rate, and a description of current population trends, including a description of the information upon which these data are based; (3) an estimate of the annual human-caused mortality and serious injury of the stock and, for a strategic stock, other factors that may be causing a decline or impeding recovery; (4) a description of the commercial fisheries that interact with the stock, including the estimated annual level of incidental mortality and serious injury of the stock from each fishery; (5) a statement categorizing the stock as strategic or not, and why; and (6) an estimate of the potential biological removal level for the stock, describing the information used to calculate it.

Many of the stock assessment reports were modified significantly in this, their first revision. Recent analyses of a 1993 ship survey have provided significant new information on the abundance of cetacean species in California waters. In addition, correction factors have been developed to estimate the fraction of long-diving whales (beaked whales, dwarf and pygmy sperm whales, and sperm whales) that are missed during sighting surveys (because they remain submerged). This new information was presented to and reviewed by the Pacific Scientific Review Group before being incorporated into the revised stock assessment reports. In addition, recent information on pinniped censuses was incorporated into the reports to update pinniped abundance estimates through 1995 (elephant seal abundance had been based on a 1991 census). Also new in these reports is the addition of a "southern resident" stock of killer whales, which had previously been lumped with the resident Alaska stock.

Takes greater than allowable levels (termed potential biological removal, or PBR) cause a stock to be listed as "strategic." As a result of new information from research at the Southwest Fisheries Science Center, West Coast stocks of several species are no longer considered strategic. The stocks eligible for reclassification are Baird's beaked whales, mesoplodont beaked whales, Cuvier's beaked whales, and pygmy sperm whales. Unless contradictory information is presented during the public comment period, reclassification will certainly make it easier for the Pacific Cetacean Take Reduction Team to meet its immediate management goals (reducing all takes below PBR levels). Several stocks—sperm whales, pilot whales, and a newly added stock, minke whales—are estimated to have gillnet takes that are greater than their PBRs, and are likely to be classified as strategic. (J. Barlow, 619-546-7178)

Cruise Report Completed for Whale Habitat and Prey Study

Blue whales were considered rare off California, but they have been abundant in summer near the Channel Islands since the early 1990s. It is assumed that these whales are feeding on aggregations of prey associated with island bathymetry and circulation patterns and with enhanced productivity related to coastal upwelling. The Center's whale habitat and prey surveys were designed to study the distribution and feeding activities of blue and fin whales by surveying the densities of their prey near the California Channel Islands, and by mapping the characteristics of physical and biological habitat that may affect the locations of the whales and their prey.

In August, NOAA research vessels *David Starr Jordan* and *Ballena* completed a survey (WHAPS96) of marine mammal habitat in the Channel Islands

region. The survey was a cooperative effort between several divisions of the SWFSC (Marine Mammal Division, Antarctic Ecosystem Research Group, and Coastal Fisheries Resources Division); another NOAA agency (Channel Islands National Marine Sanctuary); the University of California, Santa Cruz; the Cascadia Research Collective; and other research and whale-watching organizations. Researchers aboard the two vessels coordinated activities and kept in contact with other research and commercial whale-watching vessels in the area. Activities included a visual watch for marine mammals during daylight; oceanographic sampling; acoustic observations and net sampling of krill; radio tracking and tagging of blue whales; biopsy tissue sample collection; and photography of individual whales.

Findings suggest that the dynamics of prey aggregations may have an important effect on whales' distribution and activity. Further analysis of the findings should indicate why the Channel Islands are a hot spot for whales and how blue, fin, and humpback whales share the prey found there. This survey of habitat requirements for blue and fin whales contributes to SWFSC goals of monitoring and assessing the status of marine mammals, as directed by the Marine Mammal Protection Act and the Endangered Species Act. It also contributes to the NMFS strategic plan goal of recovering protected species. (P. Fiedler, 619-546-7016)

HONOLULU LABORATORY

Honolulu, Hawaii

PROTECTED SPECIES INVESTIGATION

Ecology of Hawaiian Monk Seal Being Studied

The largest population of Hawaiian monk seals is found at French Frigate Shoals, where their abundance has declined by about 55% since 1989. Many factors may be contributing to the decline, but the primary problem seems to be insufficient prey; many seals are simply starving to death. Previous management and research efforts to investigate the status of monk seals' prey and to protect critical foraging habitat have been severely handicapped by our relative ignorance of their foraging behavior and distribution.

The technology for studying the foraging behavior of monk seals has recently been developed. Researchers from the University of Minnesota and the Honolulu Laboratory are using this technology to gain information essential to protecting this endangered species and the habitat on which it depends. The goal of the studies is to describe (in three dimensions) the foraging distribution of Hawaiian monk seals from French Frigate Shoals and to test previous assumptions that the seals forage only in shallow waters close to the islands where they haul out. A description of important foraging sites and depths will make it possible to (1) identify sites that are critical to the conservation of the species, (2) assess the prey available at those sites, and (3) identify potential conflicts between seals and commercial fisheries.

Results to date have refuted earlier assumptions about the limits of the seals' foraging habitat. Both males and females have been tracked to deeper waters over banks extending well away from the islands on which the seals haul out. Concurrent studies with remotely controlled video technology are being used to map and characterize the habitat where the seals forage. Such information will significantly enhance our ability to protect the species and the habitat on which it depends, to identify and assess key prey species, and to limit or prevent fisheries interactions.

Although the current studies have made excellent progress in describing the seals' pelagic range and foraging ecology, a full understanding will require years of effort. Foraging patterns may vary by year, season, island, or size and sex class. Initial studies have focused primarily on adult seals at one site, but further studies are needed to investigate such topics as the foraging patterns of young seals. (T. Ragen, 808-943-1280, or B. Antonelis, 808-943-1239)

Report Submitted on Monk Seal Entanglements in Marine Debris

A draft report has been completed to summarize data about Hawaiian monk seals entangled in marine debris and to describe the types and amounts of debris destroyed by Marine Mammal Research Program (MMRP) field staff. The draft report updates a 1988 entanglement summary, and is the first summary of debris removed from beaches. The report also meets a request of the Hawaiian Monk Seal Recovery Team.

Since 1982, MMRP biologists have documented 129 instances of seals becoming entangled, and have

released 92 animals. The estimated annual entanglement rate is 0.63% of the population, the highest documented rate for a pinniped species. Most entanglements were found on Lisianski Island, probably because favored pupping sites are located on windward beaches, where most debris accumulates, and because pups are most susceptible to entanglement. In 1996, researchers found 22 entangled seals, the most ever documented in one year.

Since 1987, MMRP biologists have cataloged and removed more than 19,000 pieces of potentially entangling debris from beaches on which the seals haul out. Most debris has been pieces of line and shards of trawl net; other items have included driftnets and plastic rings.

Disentangling seals and destroying hazardous debris directly benefit the Hawaiian monk seal population by reducing a source of known mortality and preventing the deaths of individual seals. (J. R. Henderson, 808-943-1225)

PACIFIC FISHERIES ENVIRONMENTAL LABORATORY

Pacific Grove, California

Paper Presented on State of the California Current

In October 1996, Oceanographer Frank Schwing presented the annual overview of recent conditions in the California Current system at the annual CalCOFI Conference. The report informs scientists about recent conditions in the California Current region, primarily as determined by CalCOFI and NMFS surveys. This was the first time the overview had been presented by a Pacific Fisheries Environmental Laboratory (PFEL) scientist.

In 1995–96 the California Current showed a fairly typical circulation, but there were warm sea surface temperature anomalies for 1995 and much of 1996. Despite relatively high nutrient levels and chlorophyll concentrations inshore of the current, a pattern of low macrozooplankton biomass continued.

Presentation such as this increase the visibility of NMFS research and scientists within the fisheries oceanography community. They also provide a good general summary of recent conditions in the environment of commercial fish stocks on the West Coast. The information will be published in the 1997 *CalCOFI Reports*. (F. Schwing, 408-648-9034)

Navy Completes Transfer of Pacific Grove Facility to NOAA

After 26 years in seven different temporary quarters, the Pacific Fisheries Environmental Laboratory moved into its current facilities in Pacific Grove in April 1995 under a use agreement with the Navy. The facility, a former U.S. Naval Reserve center, had been formally deactivated by the Navy in 1994. After completion of all the needed paperwork and other requirements, it was transferred to NOAA in a ceremony held in late October 1996. This effort was undertaken to provide a permanent facility for the PFEL to assure its continued productivity and stability as it continues its important relationship with the U.S. Navy on the Monterey Peninsula.

The transfer to civilian use was highlighted as a successful example of a base closure. Deputy Assistant Secretary of the Navy William Cassidy, Jr., and NOAA General Counsel Terry Garcia officiated at the ceremony. Other speakers included Steven Honigman, General Counsel of the Navy; Nancy Foster, NOAA Deputy Assistant Administrator for Fisheries; Congressman Sam Farr; and Mayor Sandy Koffman of Pacific Grove. The ceremony was followed by tours of the facility, which featured poster and computer displays describing NOAA's cooperation with the Navy, as well as NMFS research.

The property includes 4.5 acres. The building on the site was constructed in 1952, renovated in 1989, and served several purposes until its closure in 1994. It has remained in excellent shape for current needs. In addition to office space, it contains a conference room that doubles as a lecture hall and can accommodate about 50 people. Monterey Bay National Marine Sanctuary and NMFS law enforcement personnel also occupy space in the building.

Completing this project required the efforts of many within NOAA, in addition to support from the Navy, the local community, and the general marine science community in the Monterey Bay area. It provides one of four facilities to meet the long-range plans of the NMFS Southwest Region. It also serves as a focus for the relationship between NOAA and the Navy as they gather environmental data to support fisheries. (G. Boehlert, 408-648-8515)

PELAGIC FISHERIES RESOURCES DIVISION

La Jolla, California

Cooperative Analysis Enhances Albacore Forecast

Existing albacore fishery and sea surface temperature data were examined by Fishery Biologist Norm Bartoo to develop statistical, spatial fishery predictors. Tim Barnett of the Scripps Institution of Oceanography, and the American Fishermen's Research Foundation also participated in the study. More than 224,000 logbook records of daily catch and effort data from 1961 to 1994 were examined. The fishery was divided into small areas along the Pacific coast of the United States and offshore. The predictor variable was CPUE, catch per day fished.

The analysis identified several spatial fisheries distributions on annual and within-season time scales. A number of patterns previously described in qualitative terms by fishery experts were quantified and more sharply defined. Additionally, sea surface temperature indicator patterns in the eastern north Pacific were associated with fishery patterns. The findings indicate that the method can increase the accuracy of forecasting fishery patterns from preseason information. Although a rigorous statistical preseason fishery model was found to have modest numerical predictive skill, the addition of qualitative information enhanced the predictive level, especially when the model was used by persons with practical experience and some information about the location of the fishery for the current season.

The results of this analysis should increase the accuracy of the Center's albacore forecast which is made available to approximately 600 fishermen in the U.S. Pacific albacore troll fishery. The forecast sets forth the most likely scenario for the early-season availability of fish, and predicts the most likely development pattern for the commercial fishery. (N. Bartoo, 619-546-7073)

Data Revised for Purse Seine Fishery in the Western Indian Ocean

Data based on logbook returns from fishing vessels for the second quarter of 1996 were received from the Seychelles Fishing Authority and added to the SWFSC Tuna Global Database. The database serves as a resource for fisheries management advice and for research on conserving tuna stocks of interest to the United States.

In the second quarter of 1996, an average of 34 vessels (14 Spanish, 14 French, and a combination of 6 Belizean, Liberian, Mauritian, and Panamanian) participated monthly in the western Indian Ocean purse seine fishery, compared to 46 vessels during the same period in 1995. The number of vessel days fished was 2,471, down 27% from the previous year. Catches of skipjack, yellowfin, and other tunas (mainly bigeye and albacore) during the second quarter of 1996 totaled 39,873 metric tons (t), down 38% from the previous year (Fig. 1). The species composition was 57% skipjack, 31% yellowfin, and 12% other tunas. The average catch rate for all tuna species was 16.1 t per day fished, down 15% from the previous year (Fig. 2). Catch rates for skipjack and yellowfin tunas were 9.2 t and 5.0 t per vessel

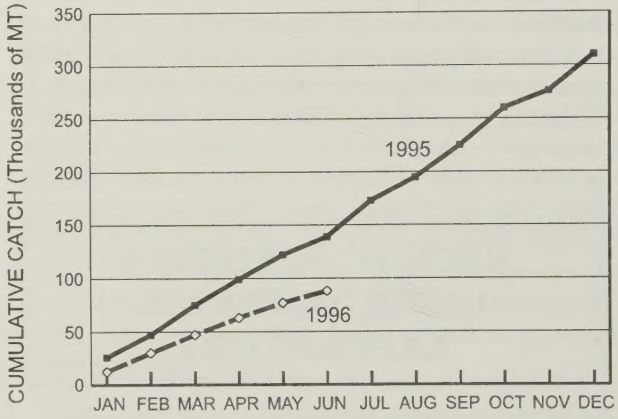

Figure 1. Cumulative catches (metric tons) of yellowfin and skipjack tuna by purse seiners in the western Indian Ocean, 1995-96.

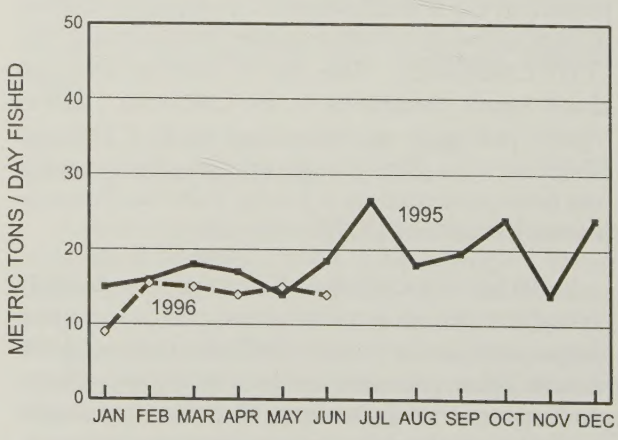

Figure 2. Catch rates (metric tons per day fishes) for purse seiners fishing in the western Indian Ocean, 1995-96.

day, respectively, compared to 11.0 t and 4.9 t per day for the previous year.

For the first two quarters of 1996, 48 purse seiners logged 5,622 vessel days of fishing and caught 86,824 t of tuna, down 37% from the previous year. The species composition was 51% skipjack, 36% yellowfin, and 13% other tunas. The catch rate for all tuna species was 15.4 t per day fished, down 19% from the previous year. Catch rates for skipjack and yellowfin tunas were 7.8 t and 5.6 t per day fished, respectively, compared to 10.9 t and 5.2 t per day fished for the previous year. (A. Jackson, 619-0546-7048)

TIBURON LABORATORY

Tiburon, California

Presence-Absence of Coho Salmon Tabulated for the Central California Coast

The collection of coho salmon presence-absence data in the central California coast evolutionary significant unit (ESU) has been completed. A list of 196 streams with historical records of coho salmon was drawn up from a variety of literature sources. Presence-absence data were gathered from other researchers whenever possible; the remaining streams were surveyed by Tiburon Laboratory personnel. Data were collected for 175 of 196 streams between 1994 and 1996. The data have been organized into table format, and are being prepared for map displays and written reports.

There had been very little data regarding the status of coho salmon in this ESU, and the primary evidence for an endangered species listing was published presence-absence data that were often as much as ten years old, and that used informed opinion as evidence. In this study, coho salmon were found in 56% of the streams in the historical record. This is higher than the previously reported 47%, indicating that the situation is not quite as severe as previously reported. Coho salmon were found in an additional 17 streams that had no historical records of occupancy. These data were incorporated directly into the Endangered Species Act listing process for coho salmon.

The revised data played a major role in changing the Biological Review Team's recommendation for the central California coast ESU from a unanimous to a close majority recommendation for endangered status. The recommendation included wording recognizing the uncertainty. This led to the NMFS Southwest Region's final decision in favor of a threatened status for coho salmon in this ESU.

In addition to its important effect on endangered species decisions, the new information will also serve as a basis for measures of recovery of coho salmon after listing. (P. Adams, 415-435-3249, ext. 232)

Fishery-Independent Index of Pacific Hake Reproductive Success Developed

Pacific hake (whiting) accounts for approximately 80% of all groundfish landings on the U. S. west coast and 10% of the ex-vessel value of the groundfish fishery. Because of its singular importance, it is the only stock that is assessed annually for the Pacific Fishery Management Council. Hake reproductive success fluctuates widely from year to year, a characteristic that causes considerable instability in the allowable biological catch (ABC). Uncertainty in projections of ABC is increased because hake do not recruit to the fishery until they are at least three years old. Current stock assessment models must project exploitable biomass into the future even though year-class strengths for the last several years are unknown.

The Tiburon Laboratory's evaluation of midwater trawl data indicates that Pacific hake year-class strength can be measured in the year of birth. A catch per unit of effort (CPUE) statistic for Pacific hake young-of-the-year (YOY) juveniles in the midwater trawl survey was calculated and compared to estimates of the recruitment of age-2 hake to the fishery. The midwater trawl index of YOY juvenile abundance and hake recruitment to the fishery two years later were well correlated ($r = 0.82$), validating the use of the survey index for future stock assessments.

The development of an index of YOY juvenile hake abundance should improve the accuracy and precision of hake stock assessments. This in turn will enhance the quality of management advice to the Pacific Council and will increase the likelihood of a sustainable hake fishery over the long term on the Pacific coast. (S. Ralston, 415-435-3149, ext. 229)

Workshop Held to Assess Extinction Risk for West Coast Salmon

On November 13–15, 1996, a group of experts on salmon biology gathered at the Sand Point Auditorium in Seattle to discuss the risk of extinction for salmon populations. The workshop was convened by the SWFSC and NMFS Northwest Fisheries Science Center.

The primary criterion for listing a species under the Endangered Species Act is the likelihood of its extinction in the near future. In considering salmon species for listing, the NMFS currently uses expert opinion to assess extinction risks. This process, however, is subjective rather than objective. For a more objective criterion based on a proper population viability analysis (PVA), the risk of extinction must be quantified on the basis of mathematical models of salmon populations and environments. Objective quantification will give NMFS managers a more accurate and defensible basis for Endangered Species Act listing decisions, assuring that at-risk populations are protected, while avoiding the costly mistake of listing populations that are not actually at risk of extinction. After a species is listed, a formal recovery plan must be developed, and the same quantitative PVA model will help evaluate alternative recovery actions.

Twelve salmon experts participated in the workshop, representing various aspects of salmon population biology and ecology. Ten papers were presented during the first two days to an audience of about 175 people. On the afternoon of the second day, three "breakout" groups offered the audience an opportunity to comment or raise issues of concern. On the third day, the panel of experts met at the Northwest Center's Montlake Laboratory to discuss issues that had been identified as especially important.

This workshop was a vital step toward achieving an objective basis for NMFS decisions about Endangered Species Act listing. The papers and discussions helped to outline the elements of a quantitative PVA approach to assessing the extinction risk for salmonids. Proceedings of the workshop are being prepared for publication. (A. MacCall, 415-435-3149, ext. 226)

INFORMATION TECHNOLOGY SERVICES

La Jolla Hosts First On-Site Visit for Information Technology Systems Architecture Project

On December 9–11, 1996, the La Jolla Laboratory hosted the first project briefing and information-gathering visit by the Architecture Working Group. The group was created by the National Information Management Board to develop an NMFS information technology systems architecture.

Thirty-eight staff members from all laboratory divisions and many job classifications participated in interviews, which yielded valuable information about the current computing environment and future needs. Information from the interviews will be used to document the current architecture and to define the target architecture.

The architecture project has been designed to assess current NMFS computing resources, identify areas for improvement, and implement the improvements. Ideally, each line office will play an integral part in a NOAA-wide systems architecture. The goal is an integrated framework for maintaining current information technology and acquiring new technology.

The working group comprises regional information technology coordinators from each financial management center; representatives from the NMFS Office of Management and Information and Office of Science and Technology, as well as the NOAA Systems Acquisition Office; and one outside consultant experienced as a computer specialist at the NMFS Northeast Fisheries Science Center. Information Technology Services Chief Rob Bistodeau is the SWFSC member.

On-site visits are part of the first phase of the Information Technology Systems Architecture Project. The group gained much helpful information during the visit, and offered suggestions for immediate technology improvements in the local system. Constructive lessons learned from this visit will be applied to similar visits at other NMFS sites around the country. (R. Bistodeau, 619-546-7055)

Geographic Information System Training Class Held

On December 2–6, 1996, a broad range of SWFSC and NMFS Southwest Region computer users gathered at the La Jolla Laboratory for training in the use of Geographic Information System (GIS) software. Information Technology Services staff planned and coordinated the on-site class, which was presented by the software vendor's (Environmental Science Research Institute) professional trainer.

Scientific users in the SWFSC have requested GIS software for many years. Its Arc/Info and Arc/View software packages are the de facto industry standard. Funds became available for the laboratory's software purchase in fiscal year 1996. The software allows users to efficiently manipulate and visualize spatial data on mapped areas. During the training class, 16 computer users received intensive GIS conceptual and hands-on training. (R. Cosgrove, 619-546-7057)

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Laboratory experiments were conducted with gestating adult yellowtail rockfish and field surveys done of females in late vitellogenesis and gestation to determine the rate of embryonic and larval development, to examine the different measures of egg quality, and to determine the rate of endogenous energy utilization and tissue assimilation. Embryogenesis and larval development followed a predictable sequence and showed rapid development with hatching occurring in 23 d and parturition in 29 d. Eggs varied in dry weight and energy content with lipid concentrations most directly contributing to the amount of energy per egg. The endogenous energy of yolk and oil globule declined rapidly throughout gestation resulting in limited yolk and oil reserves at parturition. Findings of this research will serve to allow estimation of stock biomass and will contribute to the understanding of the underlying factors that contribute to recruitment variation.

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The endemic filefish Pervagor spilosoma appeared in exceptionally large numbers throughout the major Hawaiian Islands during the spring of 1985 and remained abundant through 1988. The authors examined this occurrence with a perspective gained from studies of reef communities at the Island of Hawaii by one or both of them during most years from 1969 to 1994. P. spilosoma is known to vary in numbers, but such great abundances are rare. Although the species is considered a reef fish, individuals constituting the abundance were mostly in the water column, and spread from coastal reefs to the pelagic zone offshore. One might assume they represented an extraordinary recruitment of pelagic juveniles in the process of shifting to benthic habits, but the authors' data indicate a more complex situation. Individuals in the water column tended to be larger than individuals near the reef, and although the former were feeding on plankton when collected, many had shifted to planktivory from earlier feeding on the benthos. Also, many in the water column were ailing, with moribund and dead individuals common, and these tended to carry parasites of types known to induce their hosts to rise toward the surface. The authors suggest that the great number of filefish they observed above nearshore reefs represented the shoreward fringe of a vast pool of individuals, varied in age, that had accumulated during the exceptionally long pelagic-juvenile period that is characteristic of tetraodontiforms.

Lo, N. C. H., Y. A. Green Ruiz, M. J. Cervantes, H. G. Moser, and R. J. Lynn. 1996. Egg production and spawning biomass of Pacific sardine (*Sardinops sagax*) in 1994, determined by the daily egg production method. Calif. Coop. Oceanic Fish. Invest. Rep. 37:160–174.

MacCall, A. D. Patterns of low-frequency variability in fish populations of the California Current. Calif. Coop. Oceanic Fish. Invest. Rep. 37:100–110.

Long-term data sets include sedimentary fish-scale paleochronologies, faunal surveys from the 1800s, and the records of game fish catches maintained by the Tuna Club at Avalon since 1898. These data suggest a mode of low-frequency biological variability over a cycle of 50 to 70 years that is associated with alternation of warm and cold physical regimes. The very warm conditions in the northeastern Pacific Ocean since 1976 seem similar to conditions experienced from about 1850 to 1870. Coastal pelagic fish abundances since 1930 indicate an orderly sequence of four or five dominant species through these cycles that is very similar to the order and timing of fluctuations in catches of similar pelagic fishes in Japanese waters. The consistency and predictability of this rotation and the biological relationship to low-frequency fluctuations in physical conditions are important areas for further research. These patterns of low-frequency variability result in boom-and-bust fisheries, and pose serious problems for "sustainable development."

Macewicz, B. J., J. J. Castro-González, C. E. Cotero-Altamirano, and J. R. Hunter. 1996. Adult reproductive parameters of Pacific sardine (*Sardinops sagax*) during 1994. Calif. Coop. Oceanic Fish. Invest. Rep. 37:140–151.

MacFarlane, R. B., and E. C. Norton. 1996. Lipid and protein changes during embryo development in the viviparous genus *Sebastes*: application to the assessment of reproductive success. *In* D. MacKinlay and M. Eldridge (eds.), The fish egg: its biology and culture, p. 95-102. International Congress on the Biology of Fishes, American Fisheries Society, Physiology Section, San Francisco State University, July 14-18, 1996.

Concentrations of total lipid, protein, and lipid classes were determined in oocytes and embryos from two species of viviparous rockfishes: yellowtail rockfish, *Sebastes flavidus*, and shortbelly rockfish, *Sebastes jordani*. Total lipid protein, triacylglycerols, sterol/wax esters, nonesterified fatty acids, cholesterol, and polar lipids declined during embryo cholesterol, and polar lipids declined during embryo development. Regression analysis of changes in lipid and protein variables depending on the stage of embryo maturation found highly significant linear relationships. By solving regression equations for the final stage of embryo development, estimates of the concentrations of lipids and protein at birth were obtained. These values provide an estimate of the nutritional and structural biochemical composition of larvae at their earliest life history stage in the environment, and thus, an assessment of larval condition and reproductive quality. Data revealed significant differences in the dynamics of lipid and protein depletion during embryogenesis between the two rockfish species and among three populations of shortbelly rockfish located at Ascension, Pioneer, and Bodega submarine canyons. Estimated concentrations of lipids and protein at birth were significantly greater in shortbelly rockfish larvae from Ascension Canyon than in those from Pioneer and Bodega canyons in 1994, suggesting a greater potential survival during the time period following birth when planktonic food resources are often limited. The technique presented here to assess reproductive quality or the condition of progeny can be applied in field studies of viviparous teleosts and does not require detailed laboratory investigations of embryo development.

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Eteline snappers are an important component of commercial demersal fisheries in the central and western Pacific, but there is a substantial gap in the knowledge of their life histories, specifically the larval and juvenile stages. Juvenile pink snapper, *Pristipomoides filamentosus* (Valenciennes), ranging in size from 7 to 25 cm fork length, inhabit a nearly featureless plain offshore of Kaneohe Bay, Oahu, at depths of 65–100 m. Bottom samples and underwater video footage showed the bottom to be uniformly composed of fine, silty sand with little relief. Conductivity-temperature-depth data indicate that an internal tide brings cold water over the bottom on a tidal basis. Telemetric studies show that juveniles undergo small-scale crepuscular migrations from deeper daytime locations to shallower nighttime locations but move relatively little during day and night periods. Analysis of length frequency distributions obtained over a 17-month period resulted in an estimate of the von Bertalanffy growth constant (K) of 0.21 yr^{-1}.

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